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Kjartansdóttir, Cecília Kristín; Caspersen, Michael; Egelund, Sune Daaskov; Møller, Per

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Investigations on PVD Al/Ni electrocatalysts for alkaline water electrolysis

Cecilia Kjartansdottir, Michael Caspersen, Sune Egelund and Per Møller

Department of Materials and Manufacturing Engineering, The Technical University of Denmark

1. Introduction

1.1 Alternative electrodes for alkaline electrolysis

- Manufacturing of low-cost and efficient electrodes for alkaline electrolysis, plays a crucial role in promotion of this technique as a suitable route for renewable energy storage.

1.2 Characterization of HER and OER properties

- A new method for manufacturing of Raney type electrodes were investigated and the electrodes were characterized using conventional electrochemical techniques.

2. Experimental and procedures

2.1 Manufacturing of electrodes

- Deposition of Al by physical vapour deposition onto Ni
- Diffusion of Al and Ni leaves a Raney alloy suitable as skeletal catalyst for increased gas evolution

3. Results and discussion

3.1 Diffusion

- Up to 30 minutes heat treatment of the Al/Ni couple at 600 °C leads to a fast formation of leachable intermetallic phases (Al₃Ni₂, Al₃Ni) (Figure 1)

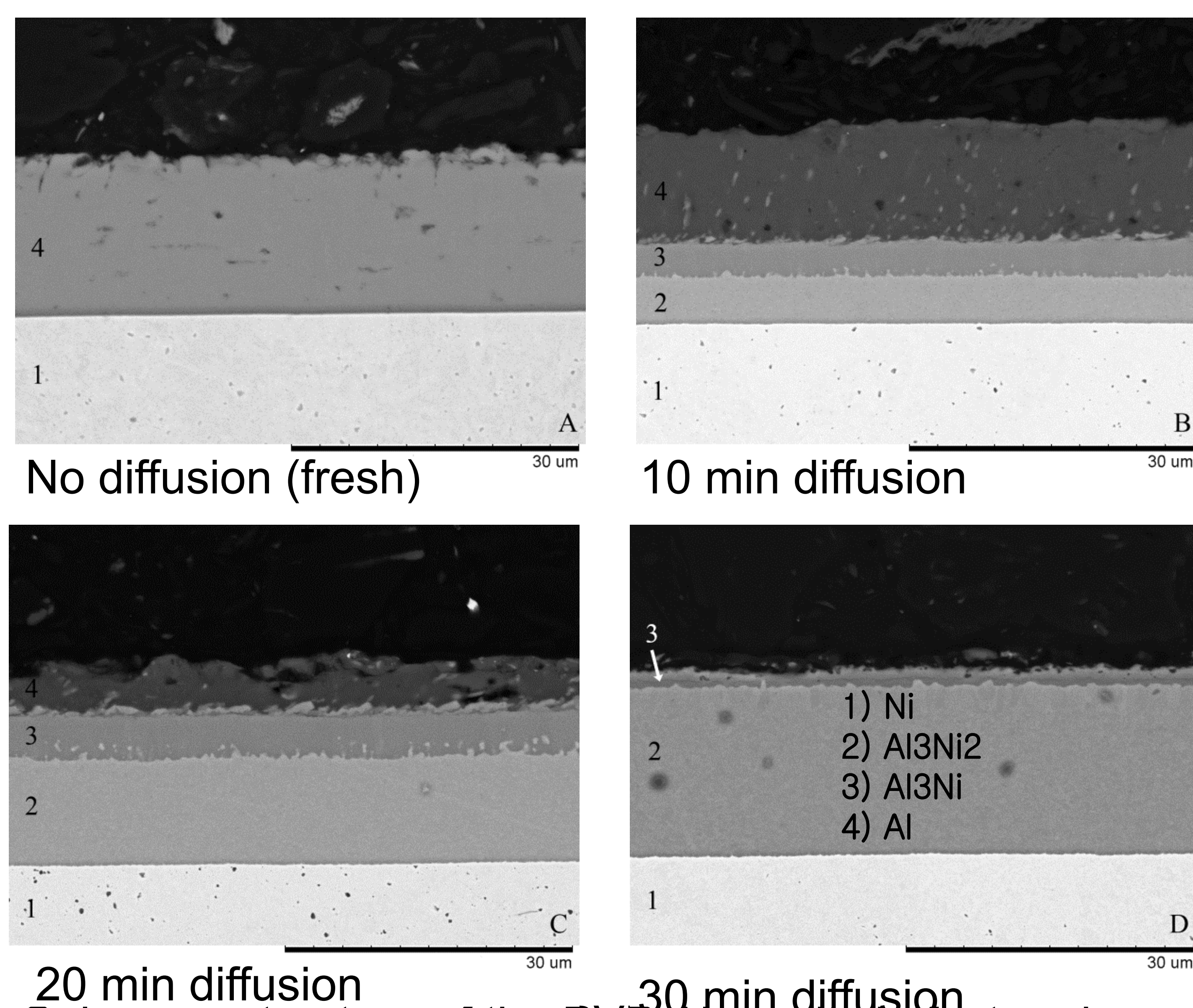


Figure 1: Diffusion of Al in Ni vs. time
- Columnar structure of the PVD Al results in fast grain boundary diffusion (Figure 2)

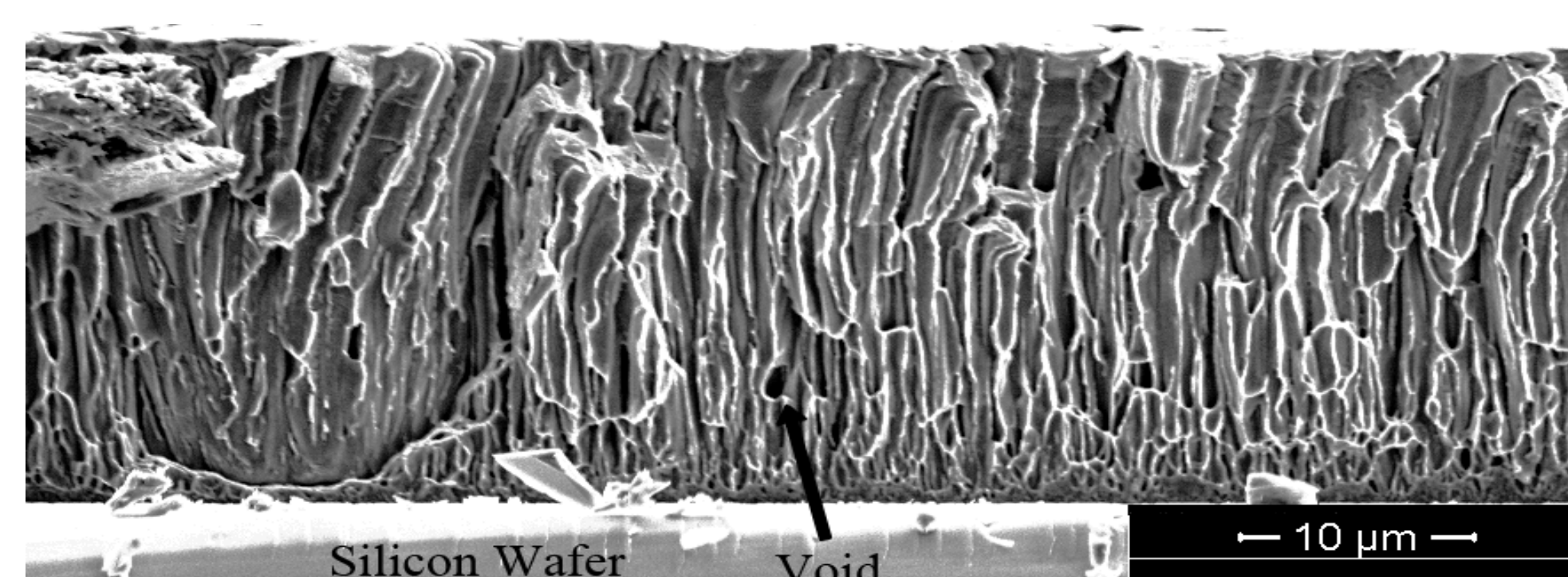


Figure 2: Columnar structure of PVD Al

3.2 Characterization of electrodes

- Hydrogen and oxygen evolution reactions were measured

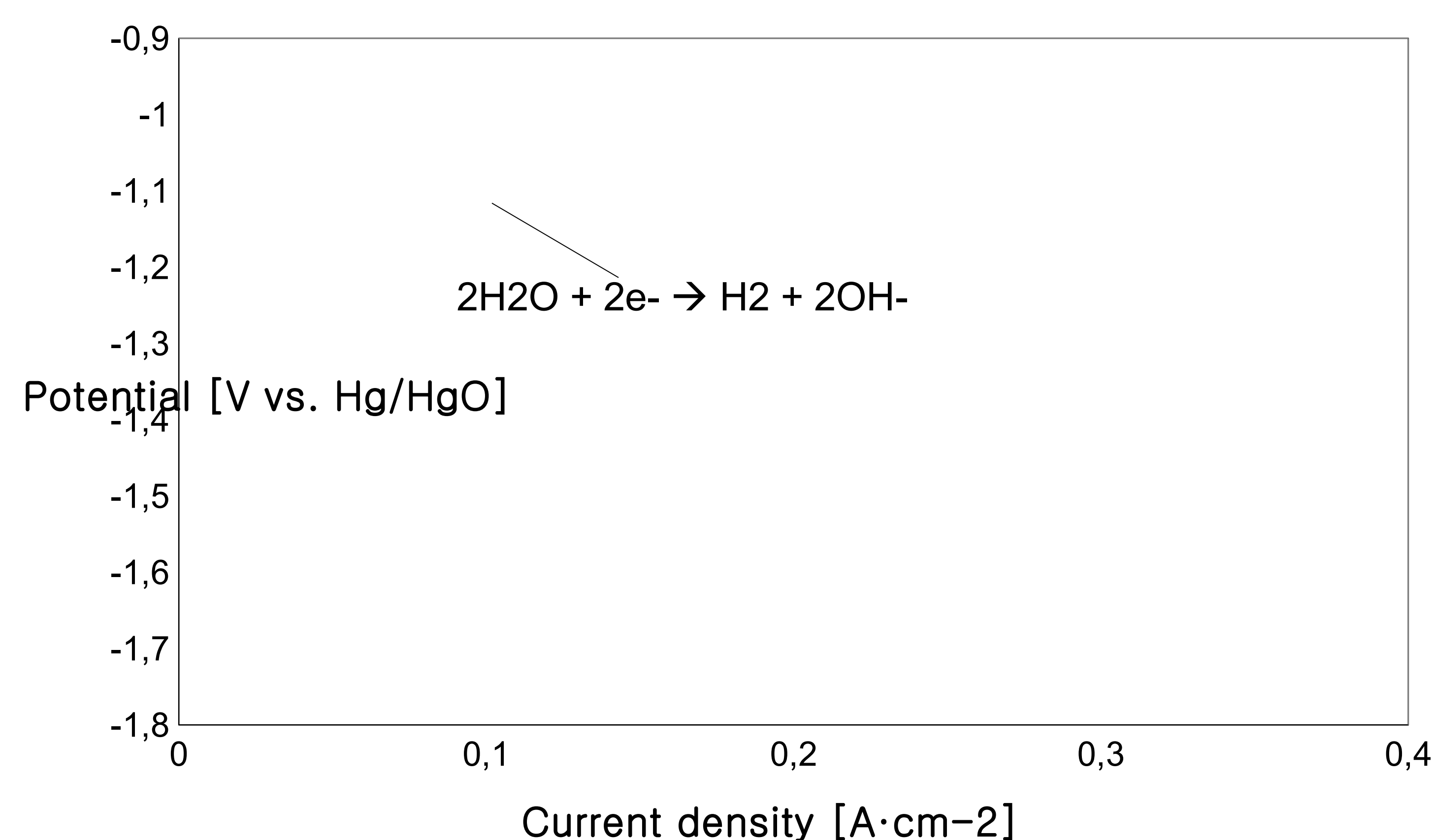


Figure 3: Overpotentials for hydrogen evolution

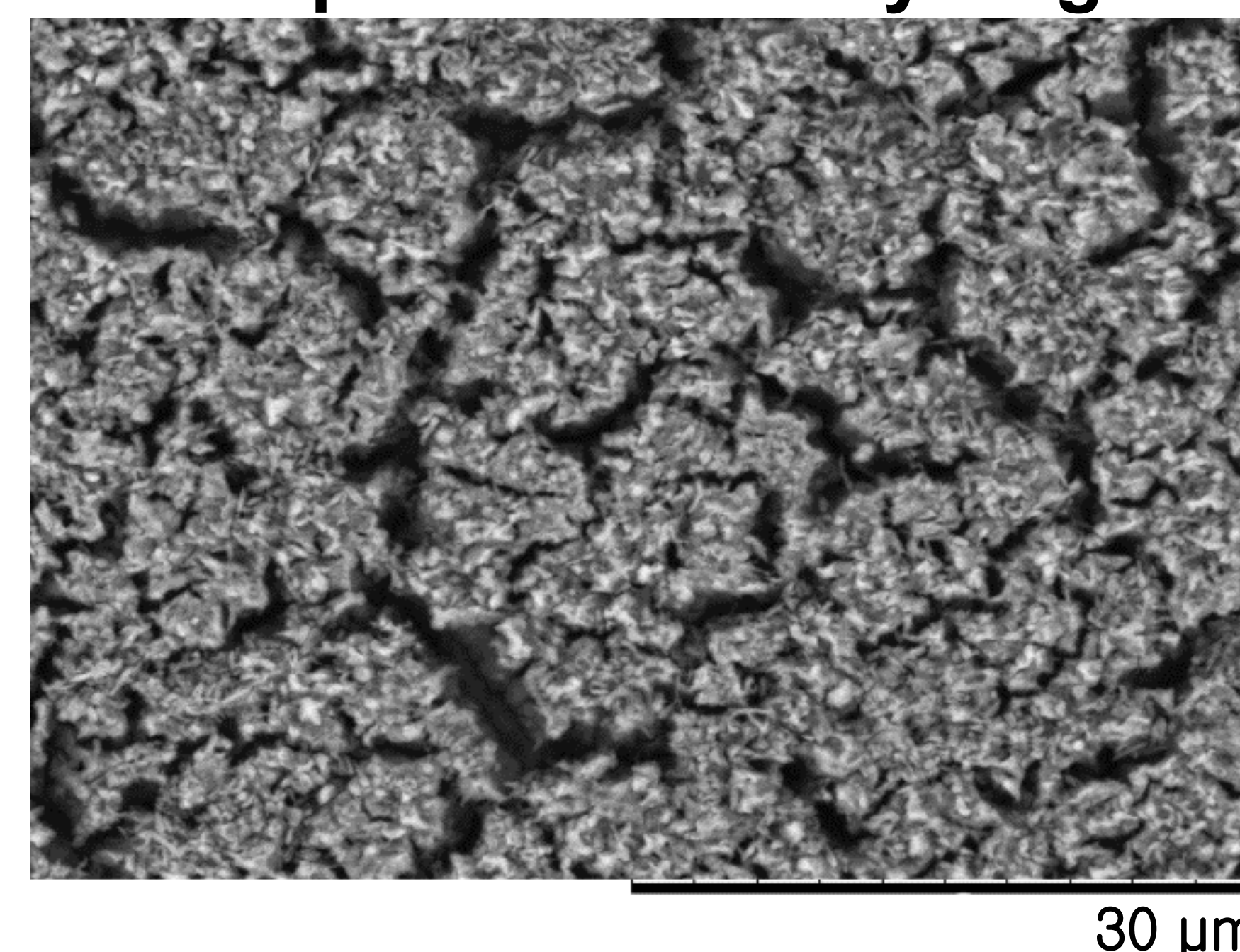


Figure 4: Top-view of activated NiAl surface

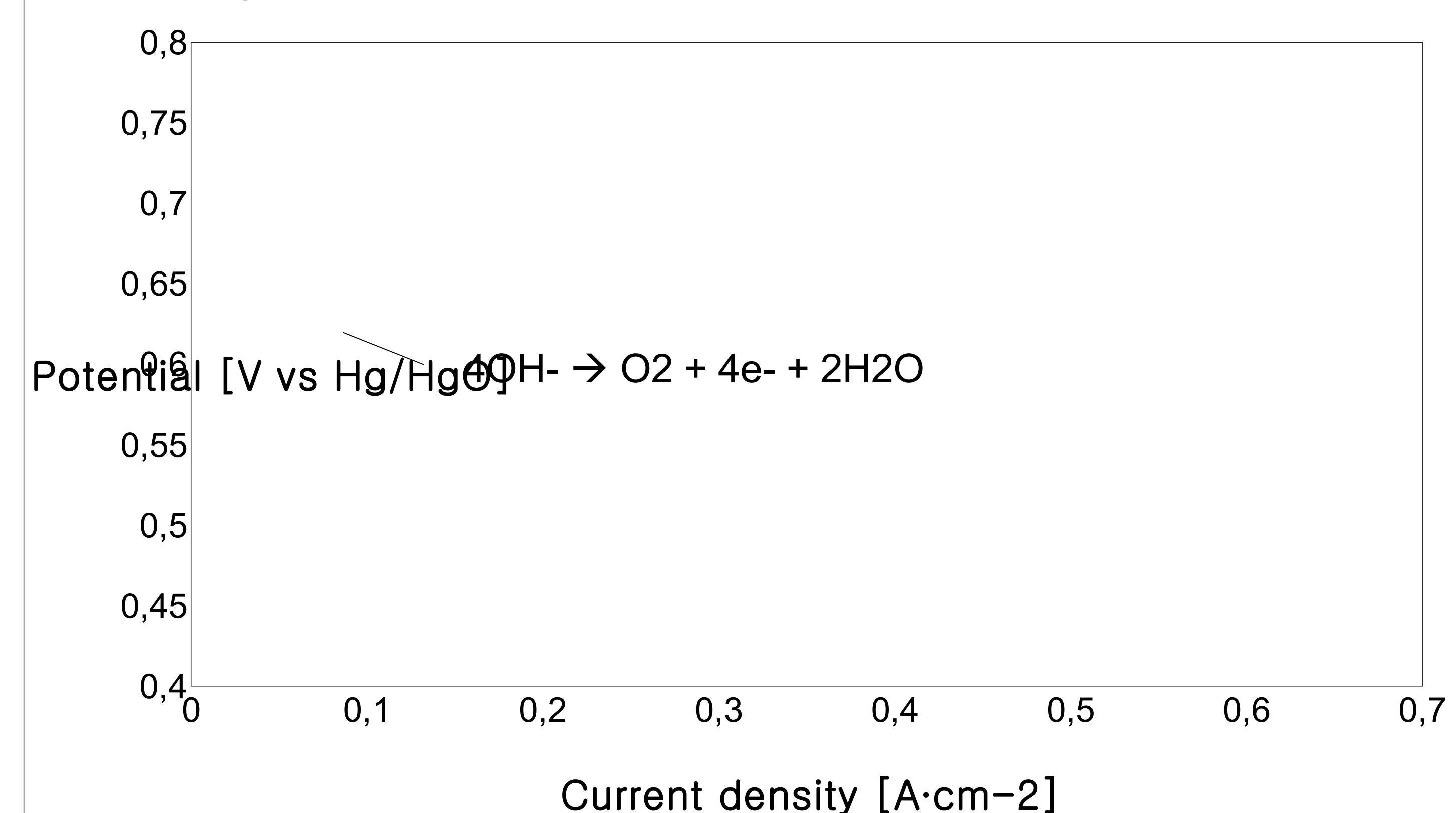


Figure 5: Overpotentials for oxygen evolution (OER)

4. Conclusion

- A porous and highly efficient electrode was created
- Fast diffusion of Nickel in columnar Aluminum occurred
- Longer diffusion times yielded higher HER activity.
- Only slight changes in activity for the OER with increased diffusion time
- HER overpotentials @100 mA/cm² as low as 123 mV (385 mV lower than polished Ni)
- OER overpotentials @100 mA/cm² as low as 338 mV (74 mV lower than polished Ni)